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ABSTRACT

This paper demonstrates that production life-cycle models provide a conceptual framework to analyze systematically the interrelationships between industrial and technological change and human resources. Section II presents the life-cycle model, focusing on its implications for the types and level of employment and skill requirements in an area. Section III uses the life-cycle framework to assess the evidence on and implications of various state programs designed for the recruitment of firms, high tech job creation, and assistance to established firms. Trends in state efforts, life-cycle implications, and potential of the state strategies are discussed for each program type. Section IV provides guidelines for states in developing effective competitiveness strategies for each of three steps: state employment assessment, inventory of state resources, and strategic thinking about employment and work force needs. The final section presents conclusions that emerge from the analysis. It focuses on defensive and proactive state actions and their long-term implications as well as on evolving responsibilities in preparing a high quality work force. The states' roles in two major areas in which labor market adjustments spill beyond the boundaries of the firm are also discussed: the skill transfer process and displaced workers. (Contains 105 references.) (YLB)

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Competitive Strategies of States: A Life-Cycle Perspective

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"Competitive Strategies of States: A Life-Cycle Perspective" by Patricia M. Flynn
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I. Introduction

States have become increasingly active in recent years in promoting industrial competitiveness and economic development. Some of these efforts involve the reorientation of programs and of existing institutions that provide training, small business assistance, and recruitment incentives. In addition, states have undertaken a variety of new initiatives, particularly in areas such as technology transfer, venture capital, and the modernization of established firms.

An extensive literature has emerged on state economic development efforts (Clarke 1986; Ganzglass and Heidkamp 1987; Fosler 1988; Eisinger 1988; Bosworth 1990; Osborne 1987; Organization for Economic Cooperation and Development [OECD] 1989). The results, however, have not been of much help to states in terms of developing competitiveness strategies that are tailored to their individual circumstances and resources. There are two major reasons for this situation. First, the materials are primarily descriptive, highlighting the actions of various communities, states, and regions. There is little evidence on the success or failure of such experiences. Moreover, for many programs, not enough time has elapsed to evaluate effectiveness, at least over the long term.

Second, these state experiments and initiatives have not been viewed in a larger analytical framework that would permit generalization and an understanding of the dynamic processes of underlying change. Lacking this larger context, the experiences of other states, no matter how detailed or successful, are of limited value to those operating under different industrial and technological conditions.

This paper demonstrates that production life-cycle models provide a conceptual framework to analyze systematically the interrelationships between industrial and technological change, and human resources. This framework—in which products, production processes, and technologies are seen as dynamic phenomena whose skill and training requirements change as they evolve—provides a theoretical model from which to draw generalizations and common themes.

The life-cycle framework suggests that states that incorporate the dynamics of industrial and technological change into their competitiveness strategies increase the likelihood of reaping employment and productivity benefits that technology can provide. In contrast, states that neglect this strategy risk increasing their vulnerability to the negative impacts of technological

change, including widespread mass unemployment and job loss.

Section II of this paper presents the life-cycle model, focusing on its implications for the types and level of employment and skill requirements in an area. Section III uses the life-cycle framework to assess the evidence on, and implications of, various state programs designed for the recruitment of firms, "high-tech" job creation, and assistance to established firms. Section IV provides guidelines for states in developing effective competitiveness strategies. The final section presents conclusions that emerge from the analysis.

II. Technology Life Cycles, Competitiveness, and Economic Development

Life-cycle models emphasize the evolutionary character of production and employment needs. Debates during the 1970s and 1980s over industrial policy and high technology focused attention on the process of industrial "birth," spurts of growth, maturation, and decline. The concept that industries pass through a series of stages during their development, however, dates back to the 1930s, when industries were found to undergo a sequence of stages—experimentation, rapid growth, diminished growth, and stability or decline—during their industrial "lives" (Alderfer and Michl 1942). More recently, separate "life cycles" have been delineated for products, for production processes, and for technologies (Dean 1950; Abernathy and Utterback 1978; Hayes and Wheelright 1979a, 1979b; Ford and Ryan 1981).

Through their impacts on skill and training requirements and on the level of employment, production life cycles can significantly affect the competitiveness and long-term economic development of an area. The technology life cycle, in particular, is a valuable tool in understanding the impacts of technological change on jobs and employment. Technologies, like products and production processes, exhibit patterns of growth and development that are characterized by sequential phases of introduction, rapid growth, diminished growth, and stability or decline (Ford and Ryan 1981; Foster 1982; Shanklin and Ryans 1984). Technologies—such as a numerical control technology, a microelectronics technology, or a data-processing technology—are introduced slowly at first, become more widely adopted as intensive research and development (R&D) efforts lead to improved performance, and are then replaced by a new and superior technology.

Technological evolution can signal impending changes in products and production processes. As a technology matures, for instance, uncertainty about its capabilities and limitations declines, and products and processes can become more standardized. Rapid product innovation accompanies the earliest phases of a technology's development, whereas process innovation peaks later in the technology's cycle as product design stabilizes. Innovations in the later stages of development of a technology, when they occur at all, are primarily minor improvements in equipment rather than major fundamental changes in either product or production process.

Skill and Training Requirements

Extension of this life-cycle model to human resource issues reveals the evolution of a skill-training life cycle (STLC) as the level of demand and standardization of skills change as a technology evolves (Chart 1).

The early stages of a technology, which are characterized by a high degree of product innovation, are relatively skill-intensive and labor-intensive. Engineers and scientists are needed to develop new products, construct pilot models, and implement design changes. These professionals also perform most of the tasks later assumed by production and marketing managers, technicians, and skilled craftsworkers. The relatively short production runs and general-purpose equipment that characterize the early stages of product development require skilled operatives who are able to perform a broad range of tasks and to adapt equipment to the company's needs. The unsettled environment surrounding emerging technologies and the lack of appropriately trained workers encourages "job enlargement," whereby employers incorporate newly created tasks into existing jobs. The firm-specific nature of skills required and the lack of appropriately trained workers in the initial stage of the STLC mean that employers at the cutting edge of new technologies must provide their own training or rely on equipment vendors to do so.

As a technology becomes more widely adopted and equipment is standardized, skills that were once firm-specific become general skills and are transferable among employers. Employers are less able to capture the return on investments in training for general skills and usually prefer that such training be provided in the schools, where the government or students will assume

Chart 1: Skill Training Life Cycle

	I Introduction: New and Emerging Skills	II Growth: Increased Demand for Skills	III Maturity: Slower Growth in Demand for Skills	IV Decline: Skill Obsolescence
Nature of Tasks	Complex	Increasingly routinized	Increasingly routinized	Narrowly defined
Type of job skills	Firm-specific	Increasingly general	General: transferable	General: transferable
Effects on job structure	Job enlargement: new positions created when significant change in skill needs occurs	Emergence of new occupations	Relatively rigid job hierarchy; occupations associated with formal education and related work experience requirements	Elimination of occupations
Skill training provider	Employer or equipment manufacturer	Market-sensitive schools and colleges	Schools and colleges, more generally	Declining number of schools and colleges; some skills provided by employer

Source: Adapted from Patricia Flynn, *Facilitating Technological Change: The Human Resource Challenge*. Cambridge: Ballinger, 1988, p. 19.

the costs. Moreover, increased demand for and standardization of skills permit their "production" on a larger scale and at locations away from the R&D sites. Together, these two forces encourage the shift of skill development from the workplace to the formal education system as technologies mature. Computer programming, keypunching, and word processing are classic examples of this transfer.

With the diffusion of established technologies, the number of experienced workers increases, as does the supply of newly trained graduates from colleges and schools. New occupations emerge, and firms alter their hiring standards. With respect to electronics, for example, firms and equipment vendors provided the necessary skills initially. As demands for these skills increased and colleges and schools expanded their curricular offerings in this field, firms adopting electronically controlled manufacturing processes expected new employees to have acquired their basic electronics skills prior to being hired. A similar pattern has subsequently occurred with computer-related skills.

As the provision of job skills shifts from the workplace to the educational system, such training is initially offered by colleges and schools that are oriented toward meeting the needs of employers. Over time, training becomes more widely diffused among educational institutions. In addition, with the growing supply of appropriately trained graduates, educational credentials become associated with particular occupations. Computer programmer positions, for example, increasingly require a bachelor's degree in a computer-related field; computer technicians need a two-year or four-year degree in a computer or technical field; and computer analysts must have a graduate degree in computer science.

While there is much upgrading and job enlargement when new technologies are adopted, the introduction of relatively mature technologies fosters discontinuous job ladders and barriers to advancement within firms. Employers adopting maturing technologies often fill their newly created skill needs with workers who have received their training at other firms or in educational institutions.

As technologies become obsolete, training focuses on replacement needs and on the retraining of workers for other fields. A limited market for skills and declining student enrollments result in the termination of occupational training programs in these fields. The responsibility for training to fill relatively short-term, skilled replacement needs shifts back to the firm.

The Geographic Location of Jobs

The implications of production life cycles for the geographic location of employment are two-dimensional. First, patterns of regional specialization of employment occur as employers seek to locate different production activities in areas best-suited to their needs. Second, changes in the labor and skill requirements over a product's life can trigger geographic shifts in employment.

On a global level, the "international product cycle model" illustrates how firms initially locate close to the source of demand for their newly developed products so they can communicate market information rapidly into product changes (Vernon 1966; Wells 1972; Vernon 1979). When foreign markets create demands for the product, they initially generate exports for the producing country. At some point, depending on the nature of the products and the characteristics of foreign demand, the expanded foreign market attracts its own production base. When production costs abroad are low enough to compensate for transportation and other costs, such as tariffs, the country that originally produced the product becomes a net importer of the good. At final stages of product development, production activities may shift from the sites of product demand to lower cost areas in other countries.

The international product cycle model suggests that countries specialize in producing goods that are consistent with their competitive advantage. Industrialized, capitalist countries will tend to focus on their research and technical capabilities,

which are critical in new, rapidly growing industries, whereas less developed countries will take advantage of their relatively low labor costs.

The "regional life-cycle model" suggests similar spatial production patterns for smaller geographic areas (Thomas 1975; Rees and Stafford 1984). With respect to human resources, in particular, the model implies that the attractiveness of regional and local economies varies with the skill needs of products at different stages of development. Early stages of product innovation and development will occur in areas in which highly skilled professional and technical workers are available to conduct R&D. Standardization and increasing output of the product trigger reduced skill requirements, inducing production shifts to geographic areas that are characterized by lower labor costs.

Empirical evidence supports the geographic location patterns suggested by these international and regional models (Malecki 1980, 1985; Ady 1983). Innovations, R&D, and new product activities, for example, require highly skilled workers, tend to be highly concentrated geographically, and are relatively stable in terms of location. As long as new models and major design changes are being introduced quite regularly, employers will not want to separate the design and testing functions from product assembly. At later stages of development, more stable production techniques and standardized equipment permit the separation of production from R&D. Competitive advantage increasingly becomes a function of unit production costs, and the relatively routinized assembly activities can be transferred to lower cost regions and countries.

Industries usually rely on a range of technologies and have products in several phases of development. Therefore, they engage in a mix of production activities that are characterized by diverse skill needs and employment patterns. The electronics industry, for example, produces both highly sophisticated products that incorporate technologies on the cutting edge and more mature consumer electronic goods, such as radios and televisions. Firms that manufacture the newer goods tend to concentrate their production operations near their R&D centers. More mature products are produced in lower cost areas. Similarly, while an increasing share of the world supply of semiconductors is produced outside the United States, in countries with relatively abundant supplies of low-cost labor, the design and development work is still highly concentrated in Silicon Valley, California (Tilton 1971; Malecki 1983; Flamm 1985).

The computer industry shows similar patterns of regional specialization and employment trends (Hekman 1980; Premus 1982). R&D, design, production of state-of-the-art equipment, and company headquarters continue to be geographically concentrated in Massachusetts and California. In contrast, the large-scale production of relatively standardized computer components and routinized assembly activities have scattered from R&D centers, and now take place in large branch plants located in states with relatively low labor costs (e.g., Tennessee, South Dakota, and North and South Carolina) or in low-wage countries (e.g., Mexico, Hong Kong, and Taiwan).

Industries with relatively little large-scale production, such as manufacturers of medical instruments, customized electronics equipment, and communications equipment, also regionalize their operations—but to a lesser extent (Hekman 1980; Malecki 1985).

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III. Competitiveness Strategies of States

States have implemented a wide variety of programs and policies in their efforts to provide jobs and improve standards of living. This section addresses the evidence and life-cycle implications of state programs that are designed to recruit employers, foster the formation of new high-tech firms, and assist established firms to retain or expand jobs. No attempt is made here to review and evaluate all of these programs; rather, the intent is to demonstrate a way of systematically thinking about and analytically assessing the impacts of such efforts.

Recruitment of Firms

Trends in State Efforts

During the 1960s and 1970s, state efforts with regard to economic growth and development focused on the recruitment of employers and jobs to the area. Seeking to differentiate themselves, states offered incentives (mainly tax and financial) to encourage firms to relocate within their borders. A relatively low-wage workforce and a good labor climate—which generally meant docile or no unions—were often highlighted in recruitment packages, particularly those offered by southern states. By the mid-1970s, it was also common for states to offer customized training programs to prospective new employers.

Historically, North Carolina has been noted for its ability to attract manufacturing plants—a majority of the Fortune 500 companies have at least one plant located in this southern, right-to-work state (Israel, Cary, McKinney, and Wartgow 1987). More recently, Tennessee and Kentucky have been successful industrial recruiters. A Nissan plant located in Tennessee in 1980; and in 1985, the state won its bid for the General Motors (GM) Saturn plant. Kentucky attracted a Toyota plant in 1985, and was first runner-up in the Saturn contest. Some northern, relatively high-wage and heavily unionized states have also demonstrated recruiting success in recent years, particularly with automotive plants. For example, a Mazda plant located in Michigan in 1986; and, in 1988, Illinois was successful in its bid to attract a Mitsubishi/Chrysler plant. Although during the 1980s recruitment efforts ceased to hold a dominant position, those efforts continue to be an active component of many states' economic development plans. For instance, competition for the Saturn plant included 38 states and 1,000 local communities (Office of Technology Assessment [OTA] 1990b).

More generally, states throughout the country sought to attract high-tech industries during the late 1970s and early 1980s (OTA 1984). These efforts often included various tax and

financial concessions and promised "tailor-made" or custom-designed workforces to accommodate the needs of individual employers. More recently, state recruitment packages (including their training components) have become complex as well as more expensive. In its successful bid for the Saturn plant, for example, Tennessee promised to spend an extra $45 million on higher education, and offered a range of technical courses (i.e., robotics and automation) for upgrading the knowledge held by GM employees in addition to a significant property tax abatement and infrastructure improvements. Michigan's recruitment of the Mazda plant included $19 million to train new workers; and Illinois offered $64 million in hiring and training assistance for the Mitsubishi/Chrysler plant (OTA 1990b).

In recent years, many states have begun to target the recruitment of new plants of firms that are expanding, rather than trying to induce employers to relocate. There has also been a trend toward greater emphasis on international investors, as states hope to lure to their sites the plants of Japanese and other foreign companies (Clarke 1986; Fosler 1988; Eisinger 1988).

Life-Cycle Implications for State Recruitment Strategies

Relocation incentives vary in their ability to attract different types of jobs and employers. Competition that involves relatively standardized production activities is mainly a function of price. In contrast, in the earlier stages of development, firms compete primarily through offering innovation or product differentiation. Incentives, such as low wages and tax abatements, will be a greater inducement to plants operating at the latter stages of the production cycle, than to firms involved primarily with R&D and entrepreneurial activities. Similarly, short-term customized training programs are likely to appeal to employers who are engaged in large-scale mass production processes but would be of little value to firms that are characterized by complex, nonstandardized activities, which require relatively high-skilled and broadly trained workers.

The life-cycle framework helps to explain why the extensive literature on business-location decisions yields widely divergent findings. Large-scale statistical studies on the relative impact of factors such as taxes, wage rates, and transportation costs on the spatial patterns of employment, for instance, generally have failed to produce significant results. Studies of high-tech industries in the 1980s also failed to provide guidance on how to attract these firms. Some of the latter studies highlight the importance of a supply of professional and technical talent and agglomeration economies that are derived from an established high-tech base. However, other studies that cite the dispersion of employment in high-tech industries to lower cost areas suggest that tax breaks, a supply of low-cost labor, and state-offered training program support are critical factors in a technology-based economic development strategy.

The use of industry-wide data in location studies contributes in large part to these inconsistencies. Most industries, as well as many, especially larger, firms encompass products, processes, and technologies at various stages of maturity. Industry-wide data, therefore, combine production activities that require different capital and labor requirements with diverse location needs. This level of aggregation masks the real processes of change and can mislead state economic development efforts (Nelson and Winter 1974; Krumme and Hayter 1975; Thomas 1975; Malecki 1983; Markusen 1985). With respect to the recruitment of high-tech employers, for example, many states pursued firms that were selected from a targeted list of high-tech industries. However, while selected on the basis of their relatively high proportions of R&D expenditures and of professional and technical workers, the bulk of the employment in these industries is in blue-collar and clerical jobs (Doeringer and Flynn 1982). Using incentives that included tax abatements and short-term customized training programs, many states were satisfied with relatively low-skilled manufacturing jobs (i.e., assembly work of printed circuit boards as "high-tech employment" [Eisinger 1988, 270]).

In the life-cycle perspective, the concept of a high-tech *industry* is a misnomer. "High-tech" is a dynamic and relative concept that describes the earliest phase of development. High-tech employment refers only to those jobs involved with R&D, innovation, or nonstandardized production activities. The jobs in the high-tech industries that disperse to lower cost areas are primarily the low-tech or standardized production activities.

Tax abatements, which represent a relatively small portion of overall costs, have been found to be ineffective in recruiting firms, even those whose activities are in later stages of development (Eisinger 1988, 202). Recent evidence suggests, however, that incentives offering *significant* cost reductions can attract a large number of jobs to an area (OTA 1990b).

The long-term impact of recruitment efforts will depend on the nature of the jobs involved (Seninger 1989; Malecki 1991). Historically, the jobs recruited usually have been in manufacturing branch plants (Malecki 1983; Harris 1986). When compared to jobs available in firms that are indigenous to the geographic area, jobs in branch plants are more apt to involve relatively standardized production activities and be more vulnerable to further dispersion to lower cost locations as product demand and competition intensify. Given their mix of production activities and occupations, branch plants are also less likely than indigenous new firms to act as a "seed bed" or "growth pole" in stimulating spinoffs and new employment opportunities in an area (Malecki 1983; Rees and Stafford 1984; Markusen 1985). Recent anecdotal evidence does indicate, however, that several foreign auto assembly plants (e.g., Toyota in Kentucky, Honda in Ohio, and Nissan in Tennessee) have attracted supplier branch plants to the area.

Recent studies suggest further that a relatively high proportion of an area's employment in branch plants hinders the entry of more technologically advanced jobs (Malecki 1990). Empirical evidence confirms, for instance, that many of the firms that relocated to southern states in order to take advantage of a low-wage workforce and company-specific training subsequently relocated to even lower wage areas (Southern Growth Policies Board 1988). The areas remained economically depressed.

Recruitment strategies, while initially appearing quite successful, can actually undermine long-term economic growth. For instance, if tax and other financial incentives negatively impact the quality of life (i.e., by restricting education and services in the area), relocation incentives could deter the entry of employers whose workforce contains relatively high proportions of professional and technical workers. In addition, training programs that are narrowly tailored to provide employers with workers who meet relatively specific production needs can hinder the future mobility of workers (Seninger 1989). Particularly in rapidly changing labor markets, workers need to have broad enough skills to enable them to work in a variety of situations and to adjust to structural change over the course of industrial development.

The recruitment of new industries and firms can also backfire if in the process they impair the competitiveness of established employers or prompt their "premature" departure from the area. Expensive recruitment packages, for instance, can drain resources from more traditional sources of employment, which comprise the bulk of all jobs in local economies. In addition, existing companies may suffer if their state subsidizes the entry of firms that are their direct competitors. Moreover, successfully recruited new industries can "crowd out" traditional employment. For instance, labor shortages—particularly in the blue collar and clerical fields—that are attributable to the growth of new and emerging firms tend to spill over into other sectors less able to compete for workers (Flynn 1984, 1988).

Potential of State Recruitment Strategies

A relatively small number of states will be able to launch effective recruitment strategies that contribute significantly to the number of good jobs and to long-term economic development. Few businesses move their operations between states and very little employment growth has been attributed to migration

of jobs into a state (Luxenberg 1984; Berman 1985).

Historically, recruitment strategies primarily have involved low-skilled positions in manufacturing branch plants, with little potential to stimulate long-term employment growth. There is no systematic evidence that the types of jobs that have been recruited in recent years are different from those recruited in the past. If, however, state recruitment strategies provide longer and more complex education and training needs than in the past, states may be able to attract better quality jobs. More highly skilled and more broadly trained workforces are incentives that should appeal to firms that are involved with innovative, non-standardized activities in earlier stages of development. For example, Michigan, one of the top three contenders for the Saturn plant in 1985, offered a recruitment package that encouraged development of world-class manufacturing and engineering talent. While it lost its bid for the manufacturing plant, it won the company headquarters and R&D facilities, and the relatively high skilled jobs that accompany these functions (Fosler 1988, 53).

Recruitment strategies that target foreign investment and new plants, rather than relocating jobs from other states, offer opportunities for more states to benefit from such efforts. Moreover, if recruitment incentives of lower production costs are the result of productivity gains (i.e., by means of technological adoptions or the more effective use of labor), the longer-term impacts of recruitment strategies on economic development could be more positive than in the past.

High-Tech Job Creation Strategies

Trends in State Efforts

In the 1970s and early 1980s, many states began supplementing recruiting strategies with efforts to create jobs at home. The impetus behind this trend came partly from the disappointment of some states with their lack of success in recruiting. The efforts were also, however, in response to growing evidence nationally that the key to employment growth and good jobs lies in "growing your own" (Grubb and Stern 1988).

The experiences of California's Silicon Valley and Massachusetts' Route 128 demonstrate the viability of this "high tech" approach. Seeking to replicate the success of these areas, states adopted a range of high tech development (HTD) initiatives targeting toward job creation and business development (OTA 1984b). The states, especially Pennsylvania, Michigan, and Massachusetts, were front-runners in experimenting with new job formation through technology and innovation strategies. In recent years, programs that are directed at R&D and technology transfer have proliferated throughout the United States.

Efforts to stimulate technological innovation have taken a variety of forms, including research institutes, industry-university partnerships, matching grants, and research parks (Clarke 1986; American Association of State Colleges and Universities 1986; Eisinger 1988; Fosler 1988). University-based research centers, such as the North Carolina Center for Microelectronics, the California Microelectronics Innovation and Computer Opportunities (MICRO) center, and Massachusetts' Centers for Excellence, conduct applied research in exchange for funds from a mix of state and private sources. These centers allow firms to pool their resources and avoid duplicating expenses for facilities and equipment. In Pennsylvania, university-coordinated Advanced Technology Centers (ATCs) operating independently from the state, leverage public funds through matching grants for R&D projects. Michigan has created research centers, including the Industrial Technology Institute (ITI) and the Michigan Biotech Institute (MBI), which run independently from the universities, and are financed primarily by private foundations.

Research parks, which encompass concentrations of R&D firms, are also geared toward generating and hastening the transfer of new ideas to the market. In 1984, there were approximately 150 research parks in the United States, almost double the number that existed a decade earlier (Eisinger 1988, 286-287).

State involvement in helping high-tech start-up firms has also grown in recent years. All fifty states now operate programs to

assist small businesses, and most have programs designed to stimulate the formation of new firms. Traditionally, small business assistance programs offered technical and managerial help; increasingly, states are expanding these efforts to include more entrepreneurial and financial assistance.

In a few states, small business "incubators" have been created. Incubators provide shared services (i.e., legal assistance, conference rooms, accounting services, and research facilities) to start-up firms at relatively low rents. Evidence suggests that firms that "hatch" from incubators have a significantly better chance for survival than small firms in general (Osborne 1987, 45).

Most recently, state initiatives to create and develop new firms have involved influencing private investment practices and filling gaps in capital markets. By the mid-1980s, most states were funding venture capital programs to finance new and emerging businesses. These programs are generally quite small and involve very few jobs (Eisinger 1988). The programs, some of which require matching funds from the firms, often seek to expand or change existing lending practices in the private sector. They may, for example, support firms that might not have approached traditional sources of "seed" money, or encourage private investments in potentially productive projects which traditionally have been bypassed as too risky.

These "entrepreneurial" venture capital programs are bringing states into relatively unfamiliar territory for public sector institutions.

> Whereas the traditional industrial development loans went mostly to existing firms, which backed their borrowing with collateral, the new programs focus on startup operations, small business at the early stage of development, and new product development. Venture loans often do not require collateral. Many venture arrangements involve equity investments, a degree of involvement unknown in the old industrial financing programs (Eisinger 1988, 264).

Life-Cycle Implications for State "High Tech" Job Creation Strategies

The life-cycle framework helps to clarify the role of new and emerging businesses in economic development. The creation and development of new entrepreneurial firms, which are vital to long-term economic growth, require strategies that focus on the characteristics and needs of products and technologies during their early stages of development. Analyses of the high-tech Silicon Valley and Route 128 success stories accentuate the importance of innovation, research, product design, and non-routine production activities.

These studies highlight the necessity of an entrepreneurial network and a technical infrastructure that encompasses applied research and product development at universities, informal local communication networks, a scientific and technical labor force, and proximity to complementary and competitive firms and to distributors and markets (Malecki 1990, 1991). Venture capital provides the means to create and develop these new and emerging firms.

Research on the location of technology-based entrepreneurial firms offers more general confirmation of these life-cycle expectations with regard to the importance of R&D, venture capital, and skilled labor in high-tech development strategies (OTA 1984).

Empirical evidence accentuates the wide variation in the ability of states and regions to stimulate new firm formation. An established base of high-tech employment has been shown to provide areas with a decided advantage in the creation of new entrepreneurial firms. An existing agglomeration of firms in similar or related sectors is a principal determinant in both birth rates and the distribution of small technology-based firms (Malecki 1990, 258). Concentration of these resources in one area enhances the firms' productivity by creating external economies of scale in production and marketing (Markusen, Hall, and Glasmeier 1986). A self-sustaining "critical mass" of employers

can develop as the concentration of entrepreneurial firms attracts additional firms and venture capital, strengthens the technological infrastructure, attracts and retains skilled professionals, further promotes informal communication networks, and encourages new innovative activities (Malecki 1991; OTA 1984b).

The flow of venture capital further highlights the advantages of an established high-tech base and the presence of research universities in new firm formation. The availability of venture capital varies widely by state and region, with funds flowing from U.S. financial centers (e.g., New York and Chicago) to centers of innovation and technology. Empirical evidence suggests that concentrations of university R&D and large firm laboratories are associated with attracting venture capital; in contrast, federal R&D and the concentration of small firms are not (Malecki 1990, 249). California, Massachusetts, and Texas are states that regularly attract venture capital, with California alone often accounting for one-third to one-half of all U.S. venture capital. In contrast, many states have virtually no venture capital funds (Malecki 1990, 260).

While an established high-tech employment base gives an area a competitive edge in new firm formation, relatively little is known about the *initial* generation of local start-ups. The research available suggests that the initial "confluence of technological opportunity" or appearance of the first entrepreneurs is the result of the availability of start-up financing and the existence of informal (noninstitutional) personal and local contacts that are supportive of new, unproven entrepreneurs (Shapiro 1971; OTA 1984).

In both the Silicon Valley and Route 128 areas, growth was driven by local start-ups and spinoffs from companies already in the area. Despite the often-cited MIT and Stanford examples, firms (as opposed to universities or government R&D facilities) appear to be the best generators of entrepreneurs (Malecki 1990, 251). Small firms (those with less than 100 employees) have been found to be the major source of entrepreneurs, although a significant number of founders do originate from large firms.

It is important to differentiate among small firms in fashioning a high-tech development strategy. Most small businesses create no jobs after the first few years and many, particularly in the service sector, generate a lot of relatively low-paying, dead-end jobs that are conducive neither to innovation nor entrepreneurship (Tichnor 1988, 42). Relatively few small firms have the potential for growth and expansion (i.e., "seed beds" for future jobs [Ticknor 1988; Eisinger 1988]). These firms are those dominated by innovative, nonstandardized activities.

For similar reasons, given their mix of occupations and production activities, recent research suggests that branch plants may deter the formation of new firms (Chinitz 1960; Malecki 1990). It is also argued that the external control inherent in branch plant economies, whereby major corporate decisions are made elsewhere, is not conducive to generating innovative new undertakings in the area (Markusen 1985; Bergman and Goldstein 1986; Malecki 1990).

Potential of State High-Tech Job Creation Strategies

Technology-based, entrepreneurial firms are vital to economic growth because of their ability to generate spinoff jobs, new products, and new technologies, which can enhance competitiveness throughout the industrial structure (Oakey 1984; Markusen 1985; Rothwell and Zegveld 1985; Malecki 1990). New and emerging businesses have been shown to be an effective economic development tool (Segal Quince Wickstead 1985; Flynn 1988). States with significant university R&D, venture capital, and highly skilled labor have the most potential for implementing a successful competitiveness strategy based on entrepreneurial new firms (Deutermann 1966; Roberts 1970; Vester 1980; Oakey 1984; Malecki 1991). Given the nature of the R&D, technology transfer and job creation processes, however, results will not be visible for years and possibly decades. The Ben Franklin Partnership, established in Pennsylvania in 1982 and often highlighted as one of the best economic development programs in the country, is designed to enhance

productivity, create new products and processes, and increase the number of start-up firms. While in its first four years, it is said to have created or preserved only 10,664 jobs; such short-term data do not permit determination of whether the program is meeting its goals (Osborne 1987, 33). Further evaluations are needed to assess its impact over the long term.

High-tech strategies are not likely to be very effective for many states. Historically, small technology-based firms, and high-tech employment more generally, have accounted for a relatively small proportion of all employment (Riche, Hecker, and Burgan 1983; OTA 1984b). High-tech employment in the United States is concentrated geographically, with most jobs found in New England, Texas, and California. R&D activities, in particular, remain concentrated geographically in a few areas of the country (Malecki 1980, 1984, 1985).

A high-tech job development strategy will be extremely difficult, if not impossible, for relatively small areas that lack universities, technology-based companies, and skilled labor. Areas dominated by relatively mature industrial bases and technologies are also unlikely to be able to implement an effective economic development strategy around technology-based entrepreneurial firms (Chinitz 1960; Markusen, Hall, and Glasmeier 1986; Malecki 1990).

Empirical evidence suggests that the state role in new firm formation will be limited and that it will be focused on research and idea generation, rather than on technology transfer or venture capital. Historically, university-industry partnerships have fared better in the production of research than in technology transfer (i.e., commercializing the results of the research). Disputes have arisen among the partners over the research priorities and mix of basic versus applied research. In addition, research centers have generated relatively few results that are useful to corporate sponsors (Osborne 1987; Eisinger 1988; Fosler 1988; Bosworth 1990).

Initial feedback on university-industry partnership programs established during the 1980s suggests these technology transfer problems will continue. Pennsylvania's Ben Franklin Partnership and Michigan's ITI, which have goals of both research generation and technology deployment, have had greater success in delivering the former than the latter (Eisinger 1988, 287).

Empirical evidence also confirms that most research parks fail. Some are unable to attract tenants; others fail to generate spinoffs; almost all fail to stimulate technology transfer (Eisinger 1988, 287). With respect to venture capital, most state programs are quite small and probably will not prove effective in establishing the "critical mass" of high-tech firms needed to generate a self-sustained growth environment. Even those citing "success" have accounted for relatively few jobs (Fosler 1988; Eisinger 1988).

Questions also remain about the state's role as a venture capitalist. Debate continues over whether a market failure in capital markets actually exists. Evidence does suggest, however, that small firms outside existing high-tech centers are likely to have difficulties obtaining venture capital funds (Eisinger 1988; Bosworth 1990).

Lastly, studies of successful venture capital projects indicate that the reputation of the founders of new firms is the primary factor in such deals (Malecki 1990). It is questionable whether state institutions will be able to successfully tap into the informal communication networks in which these assessments are made. More generally, given the nature of venture capital (i.e., high risk financing) most efforts will fail.

Strategies to Assist Established Firms

Trends in State Efforts

Economic development efforts regarding established firms in the United States historically have focused on the prevention of job loss or on the re-employment of workers displaced from their firms. Measures to retain jobs in mature or declining industries, for example, have often included import quotas, domestic content rules, restrictions on outsourcing, and protection against unfair competition.

At the state level, cost reduction incentives (e.g., reductions in unemployment insurance, workers compensation, or taxes and direct subsidies) have been used in attempts to offset cost disadvantages in an area and to keep employers in the state. States have also taken an active role in seeking to offset the adverse consequences of technological and economic change (Ganzglass and Kiedkamp 1987). Many states have developed worker assistance centers or emergency teams to assist with plant closings and provide job search assistance, supplemental unemployment benefits, and assistance in moving. State training programs have been critical components in assisting workers who have lost their jobs.

Recent years have witnessed a trend in state programs toward assisting existing firms before a shutdown becomes eminent. Michigan's Jobs Opportunity Bank (MJOB), the Delaware's Blue Collar Jobs Act, and the New Jersey Jobs Training Program (NJJTP), for example, specifically target resources to retrain current workers and possibly forestall plant closings. Skills corporations, in which business and academic institutions worked together and shared training and retraining costs, emerged in the 1980s to assist established firms that were growing rapidly and facing skill shortages. Based on the early success of Massachusetts' Bay State Skills Program, other states—including Kentucky, Minnesota, Washington and Florida—established skills corporations. In recent years, however, some of these skills corporations have met with hard times. Florida, for example, has eliminated funding for the Sunshine State Skills Program, and the Massachusetts Bay State Skills Corporation (BSSC) appears to be in trouble.

In recent years, states have begun to take broader measures which include programs for modernization and the development of new, foreign markets, in order to bolster the competitiveness of existing firms. Michigan's Modernization Services Program (MSP) and Massachusetts' Center for Applied Technology (CAT), for example, are both programs aimed at revitalizing the states' traditional manufacturing sectors, such as autoparts, apparel, and cutting tools. These programs assist firms in the integration of new technologies by identifying both technological and training needs and by providing support and technical assistance.

The integration of new technologies into relatively mature industries is not central to most states' high-tech policies and programs (Eisinger 1988, 288). Instead, most states still focus their "technology program" funds on university R&D and on assisting start-up firms. Only about 10 percent of the $550 million spent on various kinds of technology programs in 1988 was spent on technology transfer, and on technical and managerial assistance (OTA 1990a, 173). As of 1990, only 10 states operated programs whose primary function was to assist manufacturers in technological adoptions (OTA 1990a).

In a multi-state effort, the Southern Technology Council Consortium for Manufacturing Competitiveness, was established in 1988 to utilize the states' vocational schools and community colleges to assist small and medium sized enterprises (SMEs) with new technologies (OTA 1990a, 143). In addition, some states have begun experimenting with programs to stimulate exports, in particular, helping SMEs market their products overseas (Clarke 1986; Osborne 1987; Eisinger 1988; Rose and Kotlowitz 1991).

In general, the programs designed to assist SMEs incorporate new technologies are very small and few in number. A mid-1980s survey by the Congressional Office of Technology Assessment (OTA) showed that only 2 percent of the SMEs had received extension services (OTA 1990a). A recent survey of southern states found that less than 10 percent of the SMEs considering new technologies used any state or university services for technical assistance or information (OTA 1990a, 147).

Industrial extension programs in most states are not well tied to the state's training programs or educational institutions (OTA 1990b, 70). More commonly, state programs function as referral agents to training agencies. However, most state-financed training programs have shifted their efforts toward retraining the

potentially unemployed and upgrading the skills of current workers (Stevens 1986; Creticos and Sheets 1990). California's Employment Training Panel (ETP), the nation's largest state-financed training program funded at approximately $55 million a year, was originally designed to assist firms moving into the state. It now focuses on helping existing businesses retool and reorganize in order to enhance productivity (Ganzglass and Heidkamp 1987, 9).

Increasingly, states are linking their training funds for established firms to capital investments (Ganzglass and Heidkamp 1987, 10; OTA 1990b, 143-9). Indiana's Basic Industrial Training Program (BIRT), for example, requires firms in mature industries (such as transportation, auto, steel, and heavy machinery) that are expanding or modernizing to invest in capital equipment in order to be eligible for retraining assistance. The state covers between 10 percent and 50 percent of training costs depending on the level of investment. Illinois' Industrial Training Program, which added a mature industry component to complement the traditional support of new and expanding companies, also makes training contingent on capital investment by the firms.

A few states have also begun to explore the possibilities of influencing labor-management relations and work reorganization in order to revitalize their industrial sectors. With the intent to promote cooperation rather than conflict at the workplace, Kentucky, Pennsylvania, and Ohio have instituted programs to improve labor-relations and establish employee involvement programs (Tichnor 1988). In Pennsylvania, the MILRITE Council (an acronym for "Make Industry and Labor Right in Today's Economy") has been established to help improve the state's negative labor image (Osborne 1987, 35). Labor-management relations, however, remains an area in which little has been done by states.

The Life-Cycle Implications for State Strategies to Assist Established Firms

Job retention strategies that are based on reducing costs without raising productivity will be ineffective in promoting long-term economic growth and development. As with recruitment, tax abatements or other concessions will appeal more to employers involved with relatively standardized production activities (associated with mature products and technologies) than to those firms dominated by better, higher skilled jobs. A low-cost supply of labor may delay the exodus of local manufacturing jobs, and hence provide a respite from economic decline. Over time, however, these jobs are vulnerable to relocation to even lower cost areas as demand and competition increase.

In contrast, policies that focus on bolstering the productivity of established firms can make significant progress toward increased industrial competitiveness and long-term economic growth. The life-cycle framework further accentuates the importance that a highly skilled and broadly-trained workforce will have in achieving these goals.

The life-cycle framework also helps to clarify the needs of industries that have passed beyond the initial stage of development. As described earlier, on-the-job training and more formalized employer training programs are critical for the determination and acquisition of skills required in emerging occupations. Schools and colleges cannot hope to prepare workers for emerging skill needs as they initially arise at the workplace. However, as a technology develops and as demands expand, skills become more generalized and transferable among employers. Training can and should be transferred to the educational institutions (Flynn 1988). This skill transfer process requires close, continuing collaboration between schools and employers.

For states to benefit from the job creation potential of high-tech spinoffs, education and training programs need to provide firms with skilled workers as they experience rapid growth beyond the earliest stage of development. Shortages of key tech-

nical and other skilled workers in rapidly growing new fields can send a company packing long before low cost incentives become appealing (Rosenberg 1991).

Private-public partnerships, such as skills corporations, can facilitate this transfer in the provision of skills from the workplace to the educational system (National Governors' Association 1987; OECD 1989; Carnevale, Gainer, Villet, and Holland 1990). Quantitatively, the demands for new, highly skilled labor—created by the adoption of new technologies—appear small compared to total employment needs. The failure to meet these needs, however, can hamper productivity gains and the introduction of new technologies at the workplace.

The life-cycle framework also sheds new light on mature industries. "Mature" activities and "high-tech" activities represent the extremes of the development life cycle. Activities that are "mature" are those in which technologies and products are relatively standardized, mass production predominates, skill requirements are relatively low, and there is little or no innovation taking place. Competition is primarily a function of price.

As when "high-tech" industries first became the focal point of public policies, mature industrial sectors are usually viewed as though all of their activities are at a similar stage of development. However, while mature industries (e.g., autos, textiles, steel, footwear) include mature segments, they also contain more dynamic and innovative segments (OECD 1988). Even within firms, mature segments often co-exist with high-tech segments, as well as with activities that involve products and technologies along the mid-range of the development spectrum.

In addition, mature industries are generally seen and treated as a relatively homogeneous group. However, considerable diversity exists among these industries in terms of their organizational structures, occupations, wage rates, and skill requirements. Effective revitalization strategies for mature industries will take a variety of forms including the integration of new technologies, better utilization of traditional technologies, development of specialized product niches, and reorganization of the workplace (Abernathy Clark and Kantrow 1983; Dowdy and Nikolchev 1986; Doeringer, Terkla, and Topakian 1987; OECD 1988).

States can benefit from the introduction of new technologies across a variety of established industries. New technologies permit a broader range of product and process innovations to develop new and improved products and open new markets. High-tech firms (i.e., those that produce the R&D and new products and technologies) do not have to exist in the area in order to benefit from such a strategy (Sabel, Herrigel, Kazis, and Deeg 1987; Doeringer, Terkla, and Topakian 1987).

Adoptions of new technologies play a relatively minor role in permanent job loss in the United States. On the contrary, there is growing evidence that the *failure* of firms to remain technologically competitive contributes more to workers displacement and job loss than does the adoption of new technologies (Cyert and Mowery 1987; Mowery 1987; Flamm 1988). A GAO survey, for example, cites the most significant cause of plant closings and mass permanent layoffs to be reduced product demand, followed by increased competition, high labor costs, and the high value of the dollar (GAO 1986). Product and process automation were cited by relatively few respondents as key causes for workers being displaced from the firm.

Empirical evidence suggests that the uncertainties of adopting new technologies are preferable to the *known* consequences of failing to remain technologically competitive. Adoptions of technologies in their relatively early phases of development are associated primarily with the positive impacts (e.g., upgrading, job enlargement) of technological change. In contrast, the preponderance of negative impacts (e.g., mass layoffs, unemployment) are related to adoptions of relatively mature technologies or to the failure of firms to adopt any technologies at all.

An alternative to the technology-based approach for enhancing the competitiveness of established firms involves a move toward customization and market niches. Flexible manufacturing systems (FMS), which make shorter production

runs economical and encourage product differentiation, have facilitated a trend toward greater use of small-batch production of relatively specialized (nonstandardized) products (OTA 1990b). In such instances, competition becomes a function of product differentiation and quality as opposed to price, and demands increase for more broadly trained and relatively skilled workers (Piore and Sabel 1984; Levin and Rumberger 1989). Moreover, while this shift need not involve new technologies, the changing nature of the organization (i.e., less specialized capital, more highly skilled labor, and more flexible production processes) facilitates future adoptions of more advanced technologies (Doeringer, Terkla, and Topakian 1987).

Many traditional industries contain segments of production that remain in small-batch jobs. Firms that produce custom-designed goods, such as machine shops, metal fabricators, and wood working shops, for example, often are found in traditional industries populated by small and medium sized firms. Markets for specialized products may never become large enough to take advantage of economies of scale; in addition, the failure to standardize output inhibits mass production.

The Potential of State Strategies to Assist Established Firms

The potential for state programs to enhance productivity and competitiveness through revitalization of established firms is extensive. There are two main reasons for this. First, the dynamics of technological and industrial change accentuate the ongoing need for upgrading human resources and facilities to maintain competitiveness. Second, states have only just begun to tap the opportunities available to them regarding business modernization strategies.

While still a strong competitor in terms of R&D, innovations, and technology transfer of ideas from the lab to the marketplace, the U.S. continues to lose ground in terms of technological competitiveness (Cyert and Mowery 1987; Mowery and Cyert 1988; Dertouzos, Lester, and Solow 1989; OTA 1990a, 1990b). Technology diffusion (i.e., the transmission of "best practice" technologies throughout the industrial structure) lies at the heart of our competitiveness problems. U.S. adoption rates of robotics, computerized numerical control devices, and other advanced technologies are increasingly falling behind those of our industrial competitors. Moreover, even when adoption rates are similar, U.S. firms have been found to be less efficient in their implementation (Osterman 1988; OTA 1990a).

Organizational and managerial changes are often deemed necessary to fully exploit the potential productivity gains of new technologies. Managers have been criticized, however, for failure to: (1) effectively evaluate both the short-term and long-term costs and benefits of technological adoptions; (2) adequately develop human resources to meet changing needs; (3) develop organizational structures that can exploit fully the productivity gains associated with new technologies; and (4) establish fruitful cooperative relationships with workers (Cyert and Mowery 1987; Hayes and Abernathy 1980; Drucker 1988; Hayes and Jaikumar 1988; Kelley and Brooks 1988). Examples of U.S. firms that have made significant progress in incorporating technological advances, organizational changes, and investments in human resources at the workplace do exist. However, these firms are the exception rather than the norm in U.S. industry.

Several recent state efforts to promote business revitalization show promise, although problems remain. With respect to industrial extension programs, for instance, problems continue regarding technology diffusion and the delivery of services to small firms. Efforts to increase manufacturing productivity through the transfer of technologies highlight an inevitable tradeoff: focusing programs on a narrow market segment with specialized and intensive services, and hence reaching a relatively small audience, or providing more general sets of services to a heterogeneous clientele (Wyckoff and Tornatzky 1988). Given limited resources the latter would probably force the state to act as a broker or referral service rather than a provider of comprehensive technical and training assistance.

Small firms, in particular, have difficulties with technological adoptions given costs, skill and retraining requirements, and the need to keep up-to-date (Kelley and Brooks 1988). State industrial extension and training efforts, however, reach relatively few small firms (Ganzglass and Heidkamp 1987). State officials indicate that it is hard to find small companies, assess their needs, and spend enough time with them to make a difference.

The fact that industrial extension programs are rarely integrated with state training efforts highlights other missed opportunities. Neither technology nor training in isolation of system-wide support will effectively increase productivity and jobs. However, the recent—albeit small—trend to link training with capital investments is a good step in promoting industrial competitiveness.

The shift away from recruitment and toward more efficient use of existing state resources and firms in state-financed training programs has the potential to enhance competitiveness and long-term economic growth. However, while modernization efforts generally require flexible and more broadly-trained workers, most of the state-financed training programs provide relatively short-term training for individual firms (Creticos and Sheets 1990). Upgrading efforts to enhance human resource skills have yet to demonstrate their effectiveness in promoting productivity and jobs. There has been little evaluation of in-plant training programs provided by state-financed training programs; skills corporations, too, have had few evaluations.

It is important for states to explore the *types* of jobs for which state funds are providing training, and to try to establish whether firms accepting public funds would have provided such training anyway. Matching requirements should help to limit the degree of substitution taking place; questions remain, however, about the transferability of the skills being provided. More analysis needs to be done to determine if this is the best way to bolster long-term competitiveness of workers as well as firms. In addition, analysis should be conducted to determine to what extent state funds for company-specific training programs are draining resources from other education and training institutions that provide more generalized, transferable skills.

IV. Tailoring Competitiveness Strategies to Individual States

The life-cycle perspective of competitiveness strategies is useful to states for two reasons. First, it is helpful in assessing where a state is in terms of emerging, evolving, and maturing employment opportunities, and thus what workforce preparation needs might be. Second, it can guide a state in determining where it might want to be and can help to assess how likely it is that the state will reach that goal, as well as what workforce issues will need to be addressed in order to move in that direction.

A state's economic development goals and aspirations should be reflective of its competitive strengths and opportunities (Porter 1990, 1991). In addition, the selection and design of strategies and particular programs should be tied to the state's employment base and resource mix.

States will differ with respect to their composition of employers, characteristics of the work force, institutional capabilities, and other resources. Goals and strategies, therefore, are expected to vary state to state.

Most states will select a mix of strategies (i.e., recruitment, job

creation, retention) and programs to promote competitiveness and long-term economic development. The life-cycle framework can help states systematically assess the skill and training requirements likely to be required for such measures. It can also guide states in determining the relevance of the experiences of other states to their own competitiveness strategies.

The framework does not, however, provide states a set of easy answers regarding the selection and design of strategies and programs. States have to do their homework. More specifically, public policy makers need to understand the existing employment base, the characteristics and potential of state resources, and the state's strengths on which it can build competitive advantage. To facilitate these tasks the following 3-step process outlines how states can get started in thinking strategically about their employment and workforce needs.

Step One: State Employment Assessment

Initially, states should analyze the nature and mix of their employers and jobs. This analysis requires policy makers to look beyond industry aggregates and identify the types of production activities (e.g., R&D, standardized assembly), types of employers, occupational requirements, and skill needs within the state. The likely predominance in most states of business revitalization strategies to promote competitiveness further accentuates the importance of understanding the potential and limits of the state's resources and employment base.

While each state is likely to identify additional questions relevant to its particular circumstances, Box 1 provides guidelines for conducting this employment assessment.

Box 1

State Employment Assessment

- How does the state's industrial structure compare with the national economy? How has this been changing over time?
- How does the state's occupational mix in its major industries compare with the national averages in those industries?
- Describe the extent of various kinds of production activities located in the state (i.e., the mix of branch plants, headquarters, and R & D facilities in the state). Is there a trend in recent years?
- Make a grid classifying the state's major industries and employers by development stage (i.e., emerging, growing, stabilizing, declining).
- What is the state's birth rate of new firms? How does this compare with the national average?
- What are the characteristics (i.e., industries, firms, products, technologies) of the state's high-tech employment?
- What are the characteristics (i.e., industries, firms, products, technologies) of the state's major traditional employers?
- What is the extent of entrepreneurial small firms within the state? Identify potential high growth areas.
- What industries have been the primary sources of plant closings, layoffs, and unemployment in the state in recent years? What were the reasons for these events?
- What are the needs (i.e., skills, technological, financial) of the state's traditional employers?

Step Two: Inventory of State Resources

States should develop an inventory of labor and other available resources (e.g., education and training institutions, R&D facilities, venture capital) that can demonstrate competitiveness efforts. Does the state have the types of resources necessary to effectively implement a high-tech job creation strategy or recruit good jobs? The characteristics of the state's labor force (e.g., age distribution, education levels, occupations, wages) should be compared with national averages to identify state strengths or potential problems. A state with a relatively old workforce, for instance, will face more replacement needs than others. A state with relatively high proportions of engineering and technical talent may have an advantage over others in high-tech development possibilities. A state with relatively low production wages can attract relatively unskilled production jobs. The overall structure of a state's education and training network should be identified. Moreover, the roles and track records of the institutional components of the education and

Box 2

State Resource Inventory

- How does the state's workforce compare with national statistics regarding demographic and educational factors? What are the implications in terms of education and training needs?
- What are the major R&D institutions in the state?
- What are the extent and sources of venture capital available to new firms?
- Describe the "business culture," labor climate, and status of labor relations in the state. Give examples.
- What major skill shortages and surpluses have occurred in recent years? How were these imbalances resolved?
- Describe the evolution and current status of the state's education and training network. What are the strengths and weaknesses of the various institutional components of this network?
- Which firms have used state-financed training programs? Describe the extent and types of skills provided.
- What relationships/partnerships exist between education and training institutions and employers (e.g., co-op programs, apprenticeships, advisory boards)? Have these met expectations?

training network should be assessed in terms of skill generation and responsiveness to changing labor market needs in order to understand the capabilities of the system. Box 2 provides guidelines for the development and assessment of the state's resource inventory.

Step Three: Strategic Thinking about Employment and Workforce Needs

Competitiveness strategies and programs should be assessed in the light of the state's employment and resource bases. In which activities are state policies likely to be most effective in generating good jobs and long-term economic development? In which industries? In which types of firms? Assessments, of both the short-term and long-term impacts, should be made of various recruitment, job creation and business revitalization programs previously implemented in the state. In addition, potential barriers and constraints to implementing strategies and programs should be identified. When policy options have been selected as particularly appropriate for the state, the experiences of other states in that regard may then prove particularly useful. What were the impacts of those programs elsewhere, and what problems were encountered? Box 3 provides guidelines for thinking strategically about employment and workforce needs and opportunities.

Box 3

Strategic Thinking about Employment and Workforce Needs

- What are the areas in which the state has particular strengths in the light of the employment and resource inventory assessments?
- What firms have moved into the area in recent years? Did they relocate from another state (if so, which)? Are they foreign-owned? What are their major production activities and the nature and extent of their jobs?
- What incentives have been used by the state in recruiting firms? Did those firms that have moved in take advantage of these?
- To what extent have new, high-tech firms been created in the state in recent years? In what fields? What was the source of venture capital?
- What are examples of traditional industries and firms in the state that have modernized their workplaces in recent years? Were state-financed training programs involved? Were any education and training institutions directly involved?
- Has the state been able to leverage funds to provide for training? To what extent? With which employers?
- What types of coordination and cooperation of education and training institutions appear necessary to implement the programs that appear to meet best the state's current and future employment and training needs?
- What barriers and constraints may inhibit the implementation of strategies and programs that appear to meet best the needs of the state?

V. Conclusions

A wide range of conclusions results from the life-cycle analysis of state strategies to bolster employment growth and long-term economic development. It is clear that whether states opt for recruitment, job creation, or business revitalization strategies, a well-educated and well-trained workforce is critical in creating and sustaining long-term economic growth and development. This final section will focus on "defensive" and "proactive" state actions and their long-term implications, as well as on evolving state responsibilities in preparing a high quality workforce.

"Defensive" and "Proactive" State Actions

The life-cycle framework highlights the importance of distinguishing between "defensive" and "proactive" state actions in seeking to bolster long-term economic development. Defensive actions represent an expedient way of improving competitive position by lowering costs (Doeringer and Kaboolian 1991; Doeringer et. al. 1991). They do not, however, address issues of workforce quality and technological change which underlie business performance. In contrast, proactive or "innovative" adjustment mechanisms can lower costs by increasing labor productivity, motivating workers, improving efficiency, and increasing the quality of the workforce.

With respect to labor market adjustments, for instance, layoffs and concessionary wage cuts represent defensive actions, whereas upgrading employee skills, integrating new technologies, and implementing employee-involvement programs are proactive actions. Made in response to adverse impacts of technological and economic changes, defensive adjustments became widespread during the 1970s and 1980s in relatively mature industries, such as autos, textiles, apparel, and steel. Proactive human resource adjustments have been found primarily in firms involved with products and technologies in relatively early phases of development. Small firms that engage in product specialization and produce for niche markets are also prone to seek labor productivity-enhancing adjustments, given their dependence on a skilled and flexible workforce that can respond rapidly to changing markets.

Proactive adjustments, when found in firms focused on mass production of more mature products, appear to have been implemented after defensive mechanisms have been tried. After experiencing widespread layoffs and plant closings in recent

years, for example, productivity-enhancing adjustments, such as changes in labor-market relations and employee involvement programs, are being implemented in mass production industries.

Classifying state actions as defensive or proactive can be useful in understanding the short-term and long-term impacts and tradeoffs of various policy options. Defensive state actions such as tax abatements or other financial incentives can quickly lower costs to potential employers and attract relatively large numbers of jobs in a short period of time. However, these mechanisms can undermine long-term economic growth, particularly when the types of jobs recruited are relatively low-skilled and vulnerable to further relocation to areas of even lower cost. In contrast, while proactive strategies will take longer to reduce costs, by increasing productivity the impacts regarding jobs and growth are likely to be of higher quality and longer term.

The defensive/proactive dichotomy highlights the importance of focusing public policies on "good jobs" as opposed to "jobs" *per se*. Moreover, particularly with respect to relatively mature industries where increasing competitiveness and long-term viability are often achieved with lower employment levels, "output" rather than the number of jobs may be a more appropriate measure of policy effectiveness.

In recent years, state economic development strategies have begun to focus more on proactive options and less on defensive responses. The trend away from almost exclusive focus on recruitment toward job creation and business revitalization, for instance, is indicative of the shift away from a pure cost orientation to one that emphasizes productivity and technological competitiveness. Programs that are implemented within these strategies have been evolving in a similar direction. For example, more complex recruitment packages (that include training grants for upgrading and relatively skilled positions) can reduce labor costs through productivity gains in contrast to tax abatements and other financial incentives.

With respect to business revitalization, while efforts are still limited, states are experimenting with a range of options (i.e., new technologies in older firms, more effective use of traditional technologies, customization) that have the potential to enhance productivity at the workplace. This shift toward more proactive approaches also promises more highly skilled jobs.

Moreover, proactive approaches should provide real cost savings over time, whereas defensive ones threaten to become increasingly expensive. For example, when the first few states began offering tax abatements, customized training, and so forth as recruitment strategies, these incentives helped to differentiate one state from another as they sought to attract new employers. Over time, more and more states found it necessary to follow suit, or risk their position as a serious contender. Now virtually all states offer tax and financial incentives and customized training, requiring states to incorporate additional features into recruitment packages in order to distinguish themselves from one another.

Proactive approaches have a further advantage as well: at the national level there is greater likelihood of real net employment gains, rather than just a reshuffling of jobs among states (Grubb and Stern 1989). Moreover, proactive approaches have the potential to lead the way to a "high-wage, high-skill, high living standards" option, effectively bypassing low-wage, low-skill alternatives (Cohen and Zysman 1987; Dertouzos, Lester, and Solow 1989; National Center on Education and the Economy 1990).

State Responsibilities in Promoting Competitiveness

A variety of implications emerge from the preceding life-cycle analysis for employers, unions, educators, and government officials seeking to promote competitiveness and long-term economic development. Policies are needed for both the "upside" and the "downside" of such change. Failure to adapt to newly created skill needs generated by new technologies can restrict the productivity of workers and of firms, undermining industrial competitiveness and economic growth. Failure to minimize the negative impacts of technological change as jobs

are simplified or eliminated can further constrain the benefits of technological progress.

Management can facilitate technological change through planning that integrates the natural shifts in skills with training needs and by promoting ways in which workers expect and realize better job prospects as a result of such change (Flynn 1991). Unions can foster the adoption of new technologies by developing ways to incorporate greater flexibility into the lives of workers and their organizations.

The skill-training life cycle (STLC) underscores the interrelated and evolving nature of the roles of various skill providers at different stages of a technology's life (Chart 2). It also highlights the changing role of public policy across the various stages of technological and industrial development.

Productivity-enhancing adjustments (e.g., adoptions of new technologies, improved labor-management relations) occur within firms. However, there are circumstances when the preparation for, and adjustment to, technological and industrial change should take place outside of the workplace. The life-cycle framework helps to pinpoint those places where public intervention is likely to be most effective in facilitating such change.

The dynamic nature of production life cycles and technological change highlights the need for workers who are able to adjust to skill and job shifts over time, and who are capable of absorbing job-related skills provided at the workplace. The state's education and training system should provide access to basic skill development throughout each individual's working life.

In addition, states can play key roles in two major areas in which labor market adjustments spill beyond the boundaries of the firm: (1) the skill transfer process from the workplace to the schools; and (2) when workers are displaced from their firms.

Skill Transfer Process

States should seek to prevent major skill shortages and eliminate bottlenecks that would otherwise constrain economic progress and technological advance. Firms provide workers with new skills as they initially arise. As skills become more generalized and transferable among employers, these skills can and should be transferred to other components of the education and training system.

Employment and training policies in most states have traditionally focused on schools as the primary source of job skills, while other important sources of skill development have received relatively little attention. States need to more fully integrate non-school providers of job-related skills—such as union apprenticeship programs, the military, government training programs, and firms—into employment and training programs.

The life-cycle framework underscores the need for public policy that distinguishes short-run and long-run employment conditions. Such a two-pronged policy stance is necessary in order to guard against creating structures that are so "labor market responsive" as to undermine long-term economic growth and the ability of workers to adjust to skill and job shifts over time. Rapidly changing economies need broadly-trained workers who are able to work in a variety of situations and to adjust to structural change over the course of industrial development.

State planners need to recognize that educators and employers use different time horizons when making planning and evaluation decisions—with those of employers generally far shorter than those of educators. Employer support and encouragement of particular training programs is not sufficient to justify public spending. Rather than relying on employers to solve some of their immediate staffing difficulties through changes in recruitment and internal training practices, moving quickly in response to employer requests to alleviate skill shortages may foster future skill imbalances.

Skill Obsolescence and Displaced Workers

Skill obsolescence, plant closings, and worker displacement are seen, in the life-cycle framework, as "natural" consequences of technological progress. The bulk of retraining that occurs in response to technological and structural change takes place

at the workplace. Mass permanent layoffs, plant closings, and plant relocations, however, impede the process whereby most workers acquire skills for alternative employment. States need to continue to focus on mitigating the adverse impacts of industrial and technological change, assisting displaced workers and the unemployed (Ganzglass and Heidkamp 1987).

More generally, the temptation to seek out new industries and businesses may drain resources from more traditional sources of employment. For instance, labor shortages (particularly in the blue collar and clerical fields), which are attributable to the growth of new and emerging firms, tend to spill over into other sectors less able to compete for workers (Flynn 1984). Focusing on these spill-over problems of skill replacement needs, public policy can help prevent an economic development strategy from backfiring as it impairs the competitiveness of established employers and prompts their "premature" departure from the area.

Tasks at all levels of the skill spectrum, including professional and technical, craft, maintenance, clerical, and operative, are vulnerable to deskilling and skill obsolescence. The deskilling of tasks need not, however, result in the downgrading or layoff of workers. The net result depends on the ways in which tasks are allocated among jobs and workers. Employer hiring and staffing practices play a key role in how jobs and workers are affected by change. Public policy can, however, help to minimize the negative impacts of structural change by ensuring a local skill retraining capacity for adults, which given the likelihood of worker dislocation exists even during prosperous times.

Chart 2: Responsibilities over the Skill-Training Life Cycle

Institution	I Introduction: New and Emerging Skills	II Growth: Increased Demand for Skills	III Maturity: Slower Growth in Demand for Skills	IV Decline: Skill Obsolescence
Employers	Provide training for new and emerging technologies	Provide training for firm-specific skills	Provide training for firm-specific skills	Provide training for replacement needs
Joint Labor-Management Efforts	Facilitate adoption of new technologies	Establish apprenticeship training programs where appropriate	Establish retraining programs for internal transfers of workers whose skills are soon to become obsolete	Provide training and out-placement assistance for displaced workers
Schools	Provide basic skills training	Provide training for general or transferable job skills, as well as basic skills	Provide training for general or transferable job skills, as well as basic skills	Eliminate training programs for obsolete skills; Provide basic skills
Government	Encourage adoptions of new technologies	Facilitate skill transfer from the workplace to the schools	Facilitate skill transfer from the workplace to the schools	Provide retraining for displaced workers; Assist firms in meeting replacement needs

Source: Doeringer, et al. *Turbulence in the American Workplace.* New York: Oxford University Press, 1991, p. 113.

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